

**REMARKS**

**I. Status of Claims**

Claims 1, 3, 5 and 7-15 are pending in the application.

Claim 1 is amended to recite that the zeolite membrane is formed on the foundation layer, and that the nitrogen gas permeation rate is through the porous substrate. Support for the amendments can be found at, for example, paragraphs [0010] and [0011] of the specification.

No new matter is added. Accordingly, Applicants respectfully request entry and consideration of the Amendment.

**II. Response to Claim Rejections Under 35 U.S.C. § 112**

A. Claims 1, 3, 5 and 7-15 are rejected under 35 U.S.C. § 112, first paragraph, as allegedly failing to comply with the written description requirement.

The Examiner states that Claim 1 recites, "...the porous substrate comprises a base layer and foundation layer which is formed on the base layer and is formed of the zeolite membrane...", but the specification does not provide any support for the foundation layer being formed of a zeolite membrane. The Examiner notes that at paragraph 9, the specification recites the foundation layer being formed for the zeolite membrane but not of the zeolite membrane. Claims 3, 5 and 7-15 are included in the rejected by virtue of their dependence from Claim 1.

B. Claims 1, 3, 5 and 7-15 are rejected under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite.

The Examiner states that Claim 1 recites, "...the porous substrate comprises a base layer and foundation layer which is formed on the base layer and is formed of the zeolite membrane...", and also recites that the zeolite membrane is formed over the surface of the porous substrate. The Examiner states that it is unclear how the zeolite membrane can be both the

foundation layer and also be formed on the foundation layer. Claims 3, 5 and 7-15 are included in the rejection by virtue of their dependence from claim 1.

Applicants respectfully traverse.

Claim 1 is amended to clarify the arrangement of the zeolite member and the foundation layer, with support in the specification at, for example, paragraph [0010], thereby obviating both the §§ 112, first paragraph and second paragraph rejections of the claim. Claims 3, 5 and 7-15 also comply with the requirement of §§ 112, first and second paragraphs, at least by virtue of their dependence from Claim 1. Accordingly, Applicants respectfully request reconsideration and withdrawal of the §§ 112, first paragraph and second paragraph rejections of Claims 1, 3, 5 and 7-15.

### **III. Response to Claim Rejections Under 35 U.S.C. § 103(a)**

**A.** Claims 1, 3-5 and 9-15 were rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Lai et al. (U.S. Patent No. 5,871,650) and Verduijn et al. (U.S. Patent No. 6,090,289) in view of Goldsmith et al. (U.S. Patent No. 5,221,484).

**B.** Claims 7 and 8 were rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Lai, Verduijn, Goldsmith, and further in view of Mover et al. (U.S. Patent No. 5,198,007).

Applicants respectfully submit that Claim 1, and dependent claims thereof, are patentable at least for the following reasons.

Present Claim 1 is directed to a separation membrane for separating water from organic solvent. The separation membrane comprises a porous substrate which is made of a ceramic sintered body of which a main ingredient is alumina, and a zeolite membrane which is formed over the surface of the porous substrate. The porous substrate comprises a base layer and a

foundation layer which is formed on the base layer, such that the zeolite membrane is formed on the foundation layer. The separation membrane is characterized in that a mean pore diameter of the base layer is in the range of 4-12  $\mu\text{m}$ , a mean pore diameter of the foundation layer is in the range of 0.4-1.2  $\mu\text{m}$ , the thickness of the foundation layer is in the range of 10-200  $\mu\text{m}$ , a nitrogen gas permeation rate through the porous substrate is in the range of 200-7000  $\text{m}^3/(\text{m}^2 \cdot \text{hr} \cdot \text{atm})$ , a flux Q, which is a permeation rate of water, is 5.0  $\text{kg}/(\text{m}^2 \cdot \text{hr})$  or more, and a separation factor  $\alpha$  of said separation membrane is 1000 or more. In the separation of a first material and a second material, the separation factor  $\alpha$  is expressed by the following equation (1),  $\alpha = (B_1/B_2)/(A_1/A_2) \dots (1)$ , where  $A_1$  represents the concentration % by weight of the first material before separation,  $A_2$  represents the concentration % by weight of the second material,  $B_1$  represents the concentration % by weight of the first material in a liquid or gas having permeated through the separation membrane, and  $B_2$  represents the concentration % by weight of the second material.

As described above, a flux Q, which is permeation rate of water, is 5.0  $\text{kg}/(\text{m}^2 \cdot \text{hr})$  or more, and a separation factor  $\alpha$  of said separation membrane is 1000 or more. Therefore, it is possible to provide a separation membrane which can achieve both high separation capability and high permeation rate. See, e.g., paragraph [0023] of the specification.

In contrast, Lai teaches that the mean pore diameter of the porous substrate is 0.004-2000  $\mu\text{m}$  (col. 6, line 2), the pore diameter range of the mesoporous growth enhancing layer (GEL layer) is 20-2000  $\text{\AA}$  (0.002-0.2  $\mu\text{m}$ ) (col. 4, lines 36-55), the thickness of the mesoporous growth enhancing layer (GEL layer) is 0.1-20  $\mu\text{m}$  (col. 15, line 37), and the thickness of the layer of columnar zeolite crystals is 1-100  $\mu\text{m}$  (col. 15, line 67). The porous substrate of Lai corresponds to the base layer of present Claim 1, the mesoporous growth enhancing layer corresponds to the

foundation layer of present Claim 1, and the layer of columnar zeolite crystals corresponds to the zeolite membrane of present Claim 1.

Since present Claim 1 recites that “a mean pore diameter of the foundation layer is in the range of 0.4-1.2  $\mu\text{m}$ ,” the pore diameter range of the mesoporous growth enhancing layer (GEL layer) of Lai is not included in the presently claimed range of 0.4-1.2  $\mu\text{m}$ .

Additionally, the concurrently submitted Rule 132 Declaration by Mr. Junji Saito describes experiment results for experiments that compare the separation membrane of present Claim 1 with the separation membrane described in Lai. As discussed in the Rule 132 Declaration, the separation membrane described in Lai cannot achieve both high separation capability and high permeation rate. Thus, the separation membrane of the presently claimed invention has unexpectedly superior results compared to the separation membrane described in Lai.

Turning to Verduijn, Verduijn teaches that the thickness of the intermediate layer is 1  $\mu\text{m}$  (col. 5, line 9), and the thickness of the upper layer is 0.1-150  $\mu\text{m}$  (col. 5, line 2). The intermediate layer of Verduijn corresponds to the foundation layer of present Claim 1, while the upper layer corresponds to the zeolite membrane of present Claim 1. However, Verduijn does not teach the pore diameter of the intermediate layer, which corresponds to the foundation layer of present Claim 1. Additionally, Applicants respectfully disagree with the Examiner’s characterization that at col. 5, lines 1-2, Verduijn teaches that the thickness of the foundation layer is in the range of 0.1-150  $\mu\text{m}$ , as stated at page 5 of the Office Action. In response, Applicants would like to point out that the upper layer of Verduijn corresponds to the zeolite membrane of present Claim 1.

Goldsmith teaches that the pore diameter range of the membrane coating is 0.1-5  $\mu\text{m}$  (col. 7, line 33), and the thickness of the membrane coating is 100  $\mu\text{m}$  or less (col. 7, line 36). The membrane coating of Goldsmith corresponds to the foundation layer of present claim 1. The zeolite membrane of present Claim 1 corresponds to the catalyst layer of Goldsmith. As described in Goldsmith, catalyst particles are dispersed throughout the membrane-coated filter. See, e.g., col. 5, lines 45-46. Therefore, the separation membrane for separating water from organic solvent of present Claim 1 is distinguished from the catalytic filtration device for separating solid from liquid of Goldsmith. Moreover, the separation membrane of present Claim 1 is markedly different the catalytic filtration device of Goldsmith. Thus, one of ordinary skill in the art would not have been motivated to combine the inventions described in Lai, Verduijn and Goldsmith.

In view of the above, present Claim 1 is patentable over the combination of Lai, Verduijn and Goldsmith. Claims 1, 3-5 and 9-15 are also patentable, at least by virtue of their dependence from Claim 1. Claims 7 and 8 are also patentable, at least by virtue of their dependence from Claim 1, and because Mover does not cure the above discussed deficiencies in Lai, Verduijn and Goldsmith.

Accordingly, Applicants respectfully request reconsideration and withdrawal of the § 103(a) rejections of Claims 1, 3-5 and 7-15.

### **Conclusion**

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

AMENDMENT UNDER 37 C.F.R. § 1.111  
Appln. No.: 10/590,234

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The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



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